Unit 9225

Ecological Niche Worksheet 1

Learning Objectives
By the end of this lesson you should be able to:
- Explain the concept of ecological niche
- Describe one example of an ecological niche

Student Instructions
Use the information provided on the following pages and knowledge gained in class to answer the following questions.

Questions
1. What is a habitat?
2. Explain the difference between a population and a community?
3. What is an ecological niche?
4. Explain why animals and plants have different ecological niches?
5. Describe the abiotic environmental factors that determine the ecological niche of a paua?
6. Describe the abiotic environmental factors that determine the ecological niche of a mud snail?
Ecological Niche
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Habitat
Living things or organisms are found in particular places called habitats. Examples of habitats include rock pools, mud flats and ocean trenches. For example, unsurprisingly a mud snail’s habitat is on a mudflat. The habitat of a paua is sub tidal, exposed, shallow and bouldery often subject to swell.

Each habitat is likely to be home for several species or kinds of organisms. For example, on the mudflat there are small crabs, mud whelks, cockles, pipis and wedge shells as well as mud snails. In a shallow bouldery environment there are different types of algae, kina, top shells and triple fins as well as paua.

Usually a species will not be able to live in other habitats where conditions are quite different. For example, a mud snail can’t exist in the sub tidal bouldery habitat of a paua and a paua can’t survive in the intertidal zone on a mud flat!

Within a habitat there are populations of species. A population is a group of organisms from the same species living in the same place. Populations living in a habitat form communities. Communities are an interacting collection of species found in a common environment or habitat.

Tolerance
The tolerance of organisms to different abiotic factors is reflected in the organism’s choice of habitat. For example, paua could not tolerate being exposed for long periods of time at low tide where mud snails can. Mud snails would not withstand pounding surf where paua can. This is the law of tolerances.

The law of tolerances says that: “For each abiotic factor, an organism has a range of tolerances within which it can survive. Towards the upper and lower extremes of this tolerance range, that abiotic factor tends to limit the organisms ability to survive. The wider an organism’s tolerance range for a given abiotic factor (e.g. temperature, pH, salinity, turbidity, humidity, water pressure and light intensity), the more likely the organism will be able to survive variations in that factor” (Allan et al, 2002). The tolerance of a species to abiotic factors is one factor that helps to determine where species are found. One reason that we find Paua in shallow exposed rocky places is because Paua can tolerate pounding surf. Mud snails are able to tolerate being both exposed and submerged which is one reason why they are found in the intertidal zone.
The dispersal of species is influenced by their tolerance range. The wider the tolerance range of a species, the more widely dispersed the organism is likely to be. If paua were able to tolerate mudflats and the food provided there as well as long periods of exposure at low tide then paua might be found on mudflats and shallow exposed rocky coastlines.

All organisms have an optimum range within which they function best. This is illustrated diagrammatically by Zone C in the diagram illustrating the law of tolerances. The optimum range is always narrower than the tolerance range. In the diagram the optimum range is Zone C and the tolerance range is Zone B and C. Life in Zone B or the marginal niche will often cause physiological stress for the organism. For example, if a mud snail finds itself above the high tide line for longer than is ideal it will start to dry out. If it spends too long below the water line then it will not have sufficient time to graze for food and will go hungry, spending too much time burrowed in the mud to prevent predation by fish.

The tolerance and optimum ranges may vary from one stage in an organism’s development to another or from one season to another. For example, juvenile Paua that are approximately 5-10mm in length will live in the rocky intertidal zone. Once mature paua move into the sublittoral or sub-tidal zone to a depth of between one and ten meters.

Organisms are generally most abundant where the abiotic factors are closest to the optimum range (Zone C). For this reason there will be more adult Paua found in the sub-littoral zone to a depth of ten meters than there will be on the low low tide line or below depths of ten meters. For paua the low tide line and water depths of greater than ten meters represent the
edge of their tolerance range. The sub-littoral zone to a depth of ten meters is their optimum range. Zone A is the death zone for species. Existing above the high tide line for a paua would mean death (Zone A).

**Ecological niche**
Within a habitat each species will have a special role or way of living. For example, each species has its own means by which it obtains food: Is it a grazer or a predator or does it produce its own food by photosynthesis? The role of a species in its habitat is called its ecological niche. Perhaps the ecological niche is better described as: “the functional portion of an organism in its environment, comprising its habitat and the resources it obtains there and the periods of time during which it are active” (Allan et al, 2002).

An organism’s ecological niche is defined by virtually every aspect of its life. This includes not just what it eats, but the temperature, salinity, available light and depth of where it lives, when and how it reproduces, how it behaves, and so on. For example, the role of sand hoppers can be described as scavengers of the high tide zone of sandy beaches, hiding during the day in damp sand under piles of decaying seaweed and roaming the beach at night.

**The ecological niche of paua**
Paua inhabit depths of 0 to 10m. Paua graze on fine film of algae and are particularly partial to a species of algae known as coralline turf (its pink!!) This algae grows on boulders and rocks that are clear of larger types of algae and these areas tend to be in exposed sites open to surf and heavy ocean swells. Paua have adapted to this environment. They have a low profile and a strong muscular foot that holds them to the rocks and boulders allowing them to survive the pounding surf. Paua are broadcast spawners and fertilisation takes place in the water around the paua. Their spawning is triggered by rough weather.

**Ecological niche of a mud snail**
Mud snails live on soft muddy shores between the high and low tide. They are most abundant on high tidal mudflats and on the fringes of mangroves in estuaries and harbours. Mud snails have adapted their mantel cavity so that they can breathe air. When the tide is in they can burrow themselves into the soft mud to avoid predation by fish. Mud snails eat a vast amount of mud, twice their own body weight in an hour! They then extract the nutrients and discard the rest, leaving a trail of muddy excrement behind them. Reproduction occurs through mating.

**Are any there many organisms with the same ecological niche?**
Ecological niches are important for the survival of a species. If all species had the same ecological niche then they would all compete for the same food, live in the same conditions and environment, reproduce in the same way and behave in the same way. If this were the case only some species would survive. Each habitat has limited space and resources. In fact, no two species populations can occupy the same ecological niche in a single community, one will always be superior and drive the other one into local extinction through competition.

**Competition**
Populations do not live in isolation and inevitably there is competition between one community and another for resources and space. Niche size is affected by competition. The impact of competition on niche size will depend on whether the competition is weak, moderate or intense and whether the competition is intraspecific or interspecific.
**Inter-specific competition**
Inter-specific competition occurs between one species and another. A species may compete for the same type of resources or for space. Plants often compete with one another for light and animals most commonly compete with one another for food.

Where there is only moderate interspecific competition the actual niche size of a species will be larger than where the competition is intense. When the competition from one or more closely related species becomes then an organism's niche size becomes reduced. The competition prevents the organism from exploiting all potential resources and space that would otherwise be available to it.

**Intra-specific competition**
Intra-specific competition occurs between members of the same species. When this type of competition is intense the niche size of a population increases. This is the fiercest type of competition as members of the same species have exactly the same resource requirements. They may be competing for the exact same food or light requirements. When this type of competition is occurring individuals from the population are forced to exploit resources in the extremes of their tolerance range which results in a broader niche.

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**Discussion Question**
What is your ecological niche? Consider your adaptations, feeding behaviour and abiotic requirements.

**Discussion Question**
Can you think of any animals that have the same or similar ecological niches?

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**References and additional reading:**


